Space Weather Technical Forecast

Issued on Tuesday, 19 July 2022 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storms mainly day 1 (19 July), with a slight chance on day 3 and day 4 (21 and 22 July). Decreasing chance of M-flares (R1/R2 Radio Blackouts).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low over the last 24 hours, with seven sunspots on the visible disc. None of the regions have been significantly active, with only low energy C-class flares observed. All the regions appear relatively stable, with only slight decreases in sunspot areas. A CME which left the Sun from the southwest quadrant on 18 July was analysed but does not appear to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind as observed at L1, increased from a speed of 400km/s to 550km/s, with a sharp step change at 18/2100UTC. A density increase to above average values was also observed during this time, reaching a peak of 29ppcc at 19/0309UTC. Total interplanetary magnetic field strength started at moderate values, between 8-12nT, before a further step enhancement at 18/2035UTC to 15nT, peaking at 16nT at 19/0021UTC. There was a brief lull from 19/0132UTC before a further increase to moderate levels from 19/0423UTC. This has since remained moderate, but with a declining trend since that time. The north-south component, Bz, has varied moderately, reaching a positive peak of 15.7nT at 19/0018UTC and a negative peak of -11.4nT at 19/0432UTC. The Bz has been persistently negative at around -10nT since 19/0415UTC. The phi angle was positive (away from the Sun) until 19/0118UTC, but has been weakly negative, or near neutral. Geomagnetic activity has been mainly Unsettled, with two Active periods between 0300-0600UTC and 0600-0900UTC. All these parameters are indicative of a CME arrival, with a possible contribution from a high speed stream.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, was at background levels. High energy electron flux has been moderate or low throughout the period. The 24-hour integrated electron fluence started Active (1e8 integrated pfu) but fell just below at the time of the midnight observation, falling to 8.03e7 at 19/0000 UTC.

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Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be Low, with a chance of rising to Moderate from any M-flares that occur due to the number of sunspot regions on the visible disc.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 15 July may have arrived at Earth late on 18 July, but this is currently uncertain due to the potential early arrival time. A coronal hole high speed stream, may also have connected with the Earth on 19 July. The high speed stream is likely to decline through the next two days, but the effects of the CME may persist, and could be enhanced, should there be a second CME arrival. Further coronal hole high speed stream connections are then possible either late day 3 or day 4. Geomagnetic activity is forecast to be Unsettled to Active with a chance of G1/Minor Storm intervals due to any further CME or coronal hole sourced enhancements. This risk recedes day 2 before a further enhancement later day 3 or more likely day 4 to Unsettled to Active with a chance of G1/Minor Storms.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, but with a daily slight chance of S1. The high energy electron flux (greater than 2 MeV) is forecast to be mainly moderate with a chance of rising to give diurnal peaks at high levels once current solar wind enhancements recede. This will give a chance of Active (greater than 1e8 integrated pfu) 24-hr fluence returning, mainly day 2 onward, but otherwise fluence is expected to remain below the Active level.

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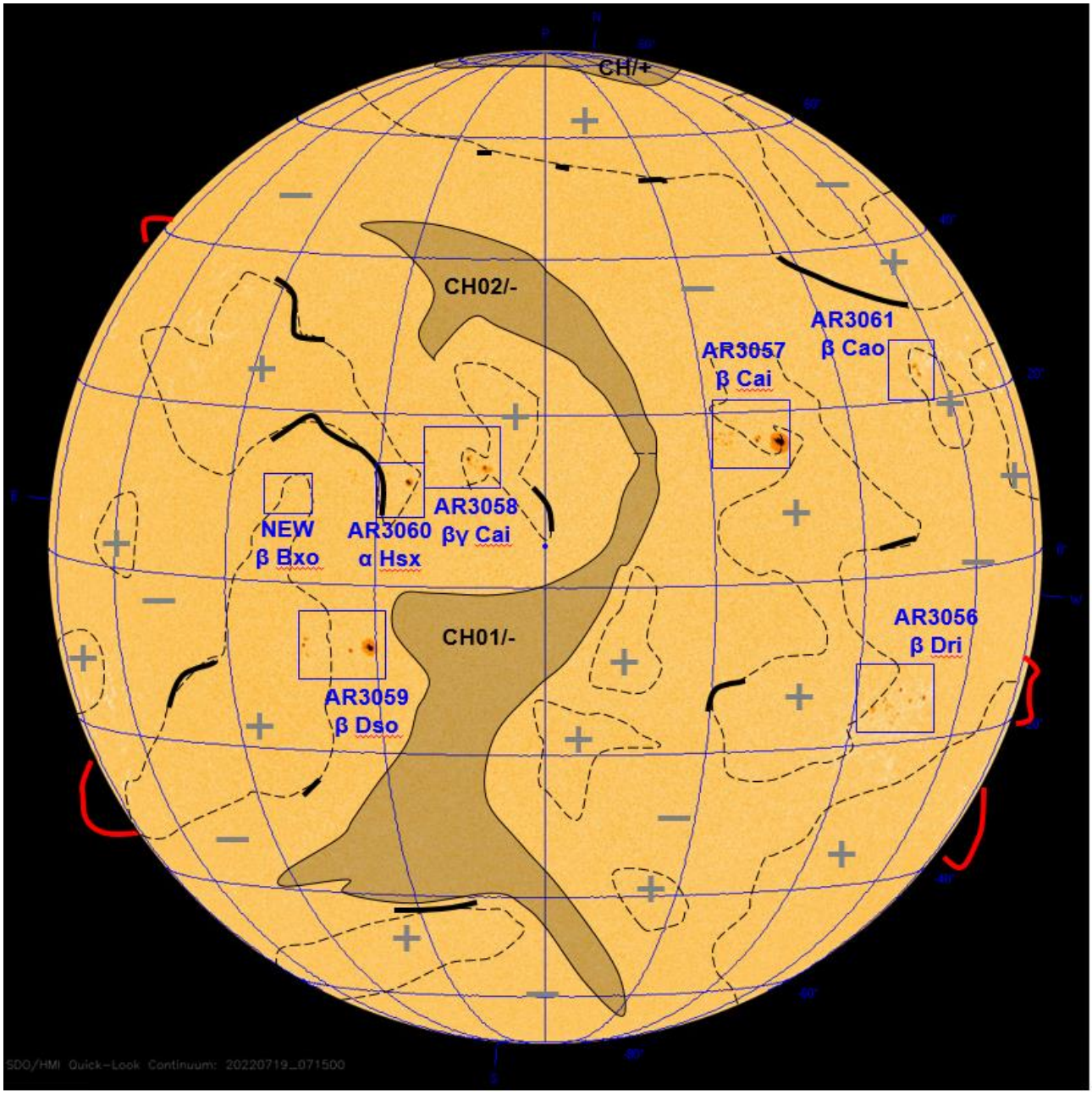
Figure 1. Solar Analysis Valid 19/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME fitfully arrived late on 18 July, with a magnetic cloud then developing early on 19 July. This may be the 15 July filament which was due to arrive later on 19 July, but given the early arrival, the forecast CME may be still due to arrive. The magnetic cloud from the CME is likely to continue to affect the Earth through much of the forecast.

A high speed stream from indistinct coronal hole 03 is also expected to connect with the Earth on 19 July, although any signs of arrival is likely to be masked by the CME signature. A further coronal hole high speed stream from a combination of coronal holes 01 and 02 is then expected to connect with the Earth either late on 21 or early on 22 July. Speeds in the solar wind are forecast to be around 500km/s.

Geomagnetic activity is forecast to be generally Unsettled to Active, with G1/Minor Storm intervals possible on 19 and 20 July. A lower risk of G1 storms on 21 July, but due to the presence of the magnetic field from the CME, further storms are possible in any sustained periods of negative Bz. Further chance of G1/Minor Storms later on 21 and into 22 July, due to the forecast connection with the next high speed stream.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	30	10	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

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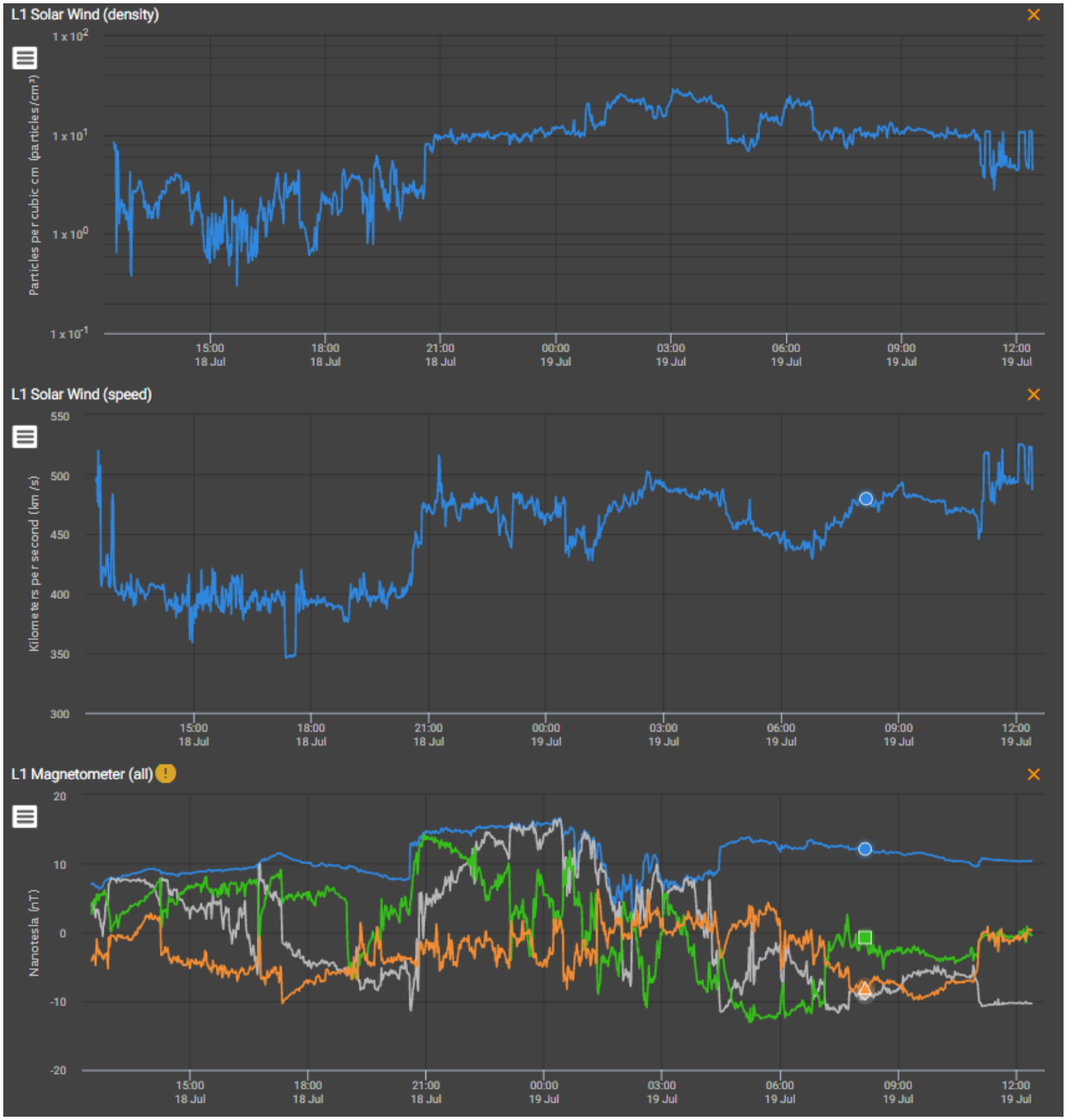
Figure 2: L1 solar wind parameters



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Radio Blackouts - X-Ray Flares:

Solar activity has been Low through the last 24 hours, with a background of C-class flaring contributing to the limited solar activity. All of the seven active regions on the visible disc are either stable or slowly declining, with no recent evidence of developing complexity. A bright flux region, evident on EUVI imagery, is due to rotate onto the visible disc on day 1 and based on the brightness, could be evidence of a significant active region.

Activity is expected to remain Low, but with a chance of increasing to Moderate with any isolated M-flares that occur.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	35	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels. There is the potential for proton flux increases due to the complexity of the Earth-facing disc, including regions on or near the west limb. However, these only give a very slight chance of proton flux reaching the S1 level (10 pfu).

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as measured at GEO is at low to moderate levels in the presence of geomagnetic enhancements. Counts are likely to remain suppressed through days 1 and 2 (19 and 20 July) in the presence of solar wind enhancements. Through days 2 and 3, the flux may increase to high levels on diurnal peaks, as the geomagnetic effects decline, along with any solar wind pressure on the radiation belts. A further reduction is then possible either late on day 3 or during day 4 (22 July) due to the onset of the CIR (co-rotating interaction region) ahead of the next high speed stream.

Associated 24 hour fluence is expected to remain below the Active threshold throughout, with no sustained periods of high electron flux likely over the next four days. There is however a risk of briefly exceeding the threshold during any lulls in activity.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	Yes	10	30	30	20
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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